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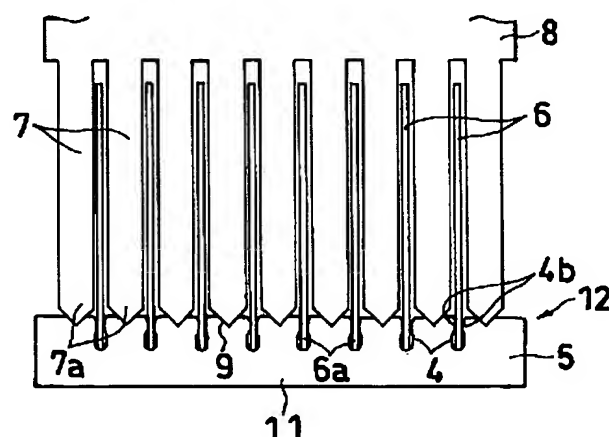
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(54) 【発明の名称】 ヒートシンクの製造法

(57)【要約】

【課題】 簡単な構造のボンチの使用でよく、またフィンを基板にかしめ止める前にフィン姿勢保持のための別の部品を必要としないようにする。

【解決手段】 ヒートシンクの製造法は、平板状基板の片面に所定間隔をおいてプレートフィン6の基部6aの肉厚より若干広い溝幅を有する溝4を多数並列状に形成し、基板5の各溝4にプレートフィン6の基部6aをはめ入れ、隣り合うプレートフィン6どうしの間および両端のプレートフィン6のすぐ外側に位置するようになされかつ横断面V状先端7aを有する板状部7を櫛歯状に備えたブレスのボンチ8により、各板状部7に対応する基板平坦部5aに板状部7の先端7aを押込み、各溝4にはめ込まれたプレートフィン6の基部6a両側をかしめ止めるものである。



## 【特許請求の範囲】

【請求項 1】 平板状基板の両面のうち少なくとも片面に所定間隔をおいてプレートフィンの基部の肉厚より若干広い溝幅を有する溝を多数並列状に形成する工程と、基板の各溝にプレートフィンの基部をはめ入れる工程と、隣り合うプレートフィンどうしの間および両端のプレートフィンのすぐ外側に位置するようになされかつ横断面 V 状先端を有する板状部を櫛歯状に備えたプレスのポンチにより、各板状部に対応する基板平坦部に板状部の先端を押込み、各溝にはめ込まれたプレートフィンの基部両側をかしめ止める工程とよりなることを特徴とするヒートシンクの製造法。

【請求項 2】 プレートフィン基部嵌入用溝の両開口縁を横断面凸弧状に形成し、かしめ止め時、凸弧状部の一部をプレートフィンの基部に面接触するように塑性変形せしめることを特徴とする請求項 1 記載のヒートシンクの製造法。

【請求項 3】 基板の厚みが 1～10 mm、プレートフィンの厚みが 0.05～2.0 mm、プレートフィンの高さが 10～150 mm、プレートフィンの中心間ピッチが 1～10 mm であることを特徴とする請求項 1 または 2 記載のヒートシンクの製造法。

【請求項 4】 平板状基板の両面のうち少なくとも片面にコルゲートフィンの波頂部の内幅より若干狭い間隔をおいてコルゲートフィンの波頂部の外幅より若干広い溝幅を有する溝を多数形成する工程と、基板の溝にコルゲートフィンの片方の波頂部をはめ入れる工程と、各溝に前記波頂部を介して波頂部の内幅より若干小さい横断面幅を有しかつ基板と同じ材質のかしめ用棒をはめ入れる工程と、コルゲートフィンの隣り合う波間に位置するようになされかつ横断面 V 状先端を有する板状部を櫛歯状に備えたプレスのポンチにより、各板状部に対応するかしめ用棒に板状部の先端を押込み、溝にはめ込まれたコルゲートフィンの波頂部の両側折曲げ垂直部の片側をかしめ止めるとともにその反対側を溝壁に圧接する工程とよりなることを特徴とするヒートシンクの製造法。

## 【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、ヒートシンクの製造法に関する。

【0002】

【従来の技術】従来、ヒートシンクの製造法として、平板状基板の片面に所定間隔をおいてプレートフィンの基部の肉厚より若干広い溝幅を有する条溝を多数並列状に形成するとともに、条溝 2 つずつを対として両溝間に開口端に向かって順次広がった凹溝を形成することにより、凹溝の両側に対峙状にかしめ用突壁部を設けかつかしめ用突壁に対向する壁を固定用突壁部となし、各溝にプレートフィンの基部をはめ入れた後、対峙する両かしめ用突壁間に、条溝にそってかしめ用治具の押圧部を移

動することにより、かしめ用突壁部をプレートフィン側に押圧し、ついで加工治具の膨隆突部を条溝にそって移動することにより、かしめ用突壁部の中間部をプレートフィン側に向かってく字状に圧潰し、プレートフィンを基板にかしめ止めるものが知られている（特許第 2715890 号公報参照）。

【0003】

【発明が解決しようとする課題】従来の上記ヒートシンクの製造法によれば、複雑な構造の加工治具を必要とするのみならず、加工治具の押圧部および膨隆突部を条溝にそって移動させるものであるから、このさい各凹溝に基部がはめ込まれたプレートフィンの姿勢を保持せしめねばならず、そのために幾つかの部品を必要とする。

【0004】本発明の目的は、簡単な構造のポンチの使用でよく、また上記のようなフィン姿勢保持のための部品を必要としないヒートシンクの製造法を提供することにある。

【0005】

【課題を解決するための手段】請求項 1 の発明によるヒートシンクの製造法は、平板状基板の両面のうち少なくとも片面に所定間隔をおいてプレートフィンの基部の肉厚より若干広い溝幅を有する溝を多数並列状に形成する工程と、基板の各溝にプレートフィンの基部をはめ入れる工程と、隣り合うプレートフィンどうしの間および両端のプレートフィンのすぐ外側に位置するようになされかつ横断面 V 状先端を有する板状部を櫛歯状に備えたプレスのポンチにより、各板状部に対応する基板平坦部に板状部の先端を押込み、各溝にはめ込まれたプレートフィンの基部両側をかしめ止める工程とよりなるものである。

【0006】請求項 2 の発明によるヒートシンクの製造法は、請求項 1 の発明において、プレートフィン基部嵌入用溝の両開口縁を横断面凸弧状に形成し、かしめ止め時、凸弧状部の一部をプレートフィンの基部に面接触するように塑性変形せしめるものである。

【0007】請求項 3 の発明によるヒートシンクの製造法は、請求項 1 または 2 の発明において、基板の厚みが 1～10 mm、プレートフィンの厚みが 0.05～2.0 mm、プレートフィンの高さが 10～150 mm、プレートフィンの中心間ピッチが 1～10 mm であるものである。

【0008】請求項 4 の発明によるヒートシンクの製造法は、平板状基板の両面のうち少なくとも片面にコルゲートフィンの波頂部の内幅より若干狭い間隔をおいてコルゲートフィンの波頂部の外幅より若干広い溝幅を有する溝を多数形成する工程と、基板の溝にコルゲートフィンの片方の波頂部をはめ入れる工程と、各溝に前記波頂部を介して波頂部の内幅より若干小さい横断面幅を有しかつ基板と同じ材質のかしめ用棒をはめ入れる工程と、コルゲートフィンの隣り合う波間に位置するようにな

れかつ横断面V状先端を有する板状部を櫛歯状に備えたプレスのボンチにより、各板状部に対応するかしめ用棒に板状部の先端を押込み、溝にはめ込まれたコルゲートフィンの波頂部の両側折曲げ垂直部の片側をかしめ止めるとともにその反対側を溝壁に圧接する工程とよりなるものである。

【0009】上記において、基板、プレートフィンおよびコルゲートフィンには、伝熱性のよいアルミニウムまたはアルミニウム合金（以下単に「アルミニウム」という）が使用される。

【0010】

【発明の実施の形態】本発明の実施の形態を以下図面を参照して説明する。

#### 実施の形態 1

この実施の形態は、請求項1および2のヒートシンクの製造法を図1～図4および図7により示すものである。まず、鍛造により、アルミニウム製平板状基板の片面に所定間隔をおいてプレートフィンの基部の肉厚より若干広い溝幅を有する溝を多数並列状に形成する。すなわち、平板状基板を第1プレスのベッド(1)にのせ、櫛歯状垂下突条(2)を並列状に有する第1プレスのボンチ(3)により加圧し、上記所定の溝(4)を有する基板(5)となす。このさい溝(4)には、その両開口縁を横断面凸弧状に形成し、凸弧状部(4a)を具備せしめるものであり、ボンチ(3)の櫛歯状垂下突条(2)の横断面をこれが形成せられる形状にすることによって得られる(図1参照)。上記溝(4)は、鍛造によって得たが、切削加工によって形成してもよい。

【0011】つぎに、基板(5)を第2プレスのベッド(図示略)に移し、基板(5)の各溝(4)にプレートフィン(6)の基部(6a)をはめ入れた後、隣り合うプレートフィン(6)どうしの間および両端のプレートフィン(6)のすぐ外側に位置するようになされかつ横断面V状先端(7a)を有する板状部(7)を櫛歯状に備えた第2プレスのボンチ(8)(図2参照)により、各板状部(7)に対応する基板平坦部(5a)に板状部(7)の先端(7a)を押込み、これに横断面V状の押込み圧痕(9)をつけると同時に、各溝(4)にはめ込まれたプレートフィン(6)の基部(6a)両側をかしめ止める(図3参照)。このかしめ止め時、凸弧状部(4a)の一部をプレートフィン(6)の基部(6a)に面接触するように塑性変形せしめ、広い面接触のかしめ止め部(4b)を得る(図4参照)。板状部(7)の上下長さは、プレートフィン(6)の基板(5)からの突出高さより、少なくともその先端(7a)を基板平坦部(5a)に押込むために降下移動する距離分長くなされている。

【0012】溝には必ずしもその両開口縁に凸弧状部がなくてもよく、図5に示すように、角(10a)のあるような通常の溝(10)を形成してもよい。この場合は、図6にかしめ止め時、線接触に近い狭い面接触のかしめ止め部(10b)を得ることになる。したがって、プレートフィン

(6)のかしめ止め前の溝(4)には、その両開口縁に凸弧状部(4a)のある方が好ましい。

【0013】上記の工程を経て図7に示すように、基板(5)のフィンのある面と反対面が半導体素子等の発熱体取付面(11)となされたヒートシンク(12)を得るのであるが、かしめ止め前、ボンチ(8)には、基板(5)の各溝(4)にプレートフィン(6)の基部(6a)をはめ入れた後、隣り合うプレートフィン(6)どうしの間および両端のプレートフィン(6)のすぐ外側に位置するようになされた櫛歯状の板状部(7)を備えているので、各プレートフィン(6)は、その両側から挟まれた状態になり、プレートフィン(6)が倒れることを防止しうる。

【0014】プレートフィンの形態は、図7に示すようななんの加工も施されていない方形状のものが一般的であるが、垂直方向の長孔(13)が複数あけられたプレートフィン(14)(図8参照)、上から垂直方向の長い切欠き(15)が複数あけられたプレートフィン(16)(図9参照)、基部(18a)を平らなまま残し、これから上方に平面からみて波状に屈曲した波状部(17)を有するプレートフィン(18)(図10参照)および基部(19b)を平らなまま残し、これから上方を先細となしたテーパ部(20)を有するプレートフィン(19)(図11参照)のようなものも適宜採用せられる。

#### 【0015】実施の形態 2

この実施の形態は、請求項4のヒートシンクの製造法を図12～図13により示すものである。まず、実施の形態1と同じ要領で第1プレスをを用いて鍛造により、アルミニウム製平板状基板の片面に角付きコルゲートフィン(21)の波頂部(21a)の内幅(W1)より若干狭い間隔をおいてコルゲートフィン(21)の波頂部(21a)の外幅(W2)より若干広い溝幅を有する第1溝(22)を多数形成するとともに、両端の同溝(22)の外側にそれぞれ前記と同様の間隔をおいてコルゲートフィン(21)の垂直端部(21b)の肉厚より若干広い溝幅を有する第2溝(23)を形成し、2種類の溝(22)(23)を有する基板(24)を得る。

【0016】つぎに、基板(24)を第2プレスのベッド(図示略)に移し、基板(24)の第1溝(22)にコルゲートフィン(21)の片方の波頂部(21a)をはめ入れるとともに、基板(24)の第2溝(23)にコルゲートフィン(21)の垂直端部(21b)をはめ入れた後、第1溝(22)に前記波頂部(21a)を介して波頂部(21a)の内幅(W1)より若干小さい横断面幅を有しかつ基板(24)と同じ材質のかしめ用棒(25)をはめ入れる(図12参照)。続いて、コルゲートフィン(21)の隣り合う波間および両端の垂直部のすぐ外側に位置するようになされかつ横断面V状先端(26a)を有する板状部(26)を、櫛歯状に備えた第2プレスのボンチ(27)により、各板状部(26)に対応するかしめ用棒(25)および基板平坦部(24a)に板状部(26)の先端(26a)を押込み、これらに横断面V形の圧痕(35)をつけると同時に、第1溝(22)にはめ込まれたコルゲートフィン(21)の波頂

部(21a)の両側折曲げ垂直部の片側およびコルゲートフィン(21)の垂直端部(21b)の片側をかしめ止めるとともにこれらの反対側を溝壁に圧接し、基板(24)のフィンのある面と反対面が発熱体取付面(28)となされたヒートシンク(29)を得る。

【0017】このかしめ止め時、かしめ用棒(25)の上角(25a)および溝(23)の外上角(23a)をコルゲートフィン(26)の波頂部(21a)の両側折曲げ垂直部の片側およびコルゲートフィン(21)の垂直端部(21b)の片側に接触するように塑性変形せしめ、狭い面接触のかしめ止め部(25b)(23b)を得る。

【0018】上記の工程を経てヒートシンク(29)を得るのであるが、かしめ止め前、基板(24)の第1溝(22)にコルゲートフィン(21)の片方の波頂部(21a)をはめ入れるとともに、基板(24)の第2溝(23)にコルゲートフィン(21)の垂直端部(21b)をはめ入れた後、第1溝(22)に前記波頂部(21a)を介してかしめ用棒(25)をはめ入れるので、コルゲートフィン(21)は正しくその姿勢を保つ。なお、コルゲートフィンの両側が図示のように垂下状でなく、立上り状のものでは、第2溝(23)は不必要である。

#### 【0019】実施の形態3

この実施の形態は、図1～図4および図7のヒートシンクの製造法と異なる請求項1および4のヒートシンクの製造法を図14により示すものであり、これは基板(30)の両面にフィン(31)(32)を片寄って具備せしめ、残りの両側平坦面を発熱体取付面(33)となしたヒートシンク(34)を得るものである。両発熱体取付面(33)は必要に応じいずれかの片面または両面が使用される。フィンの形態は、上記したプレートフィンおよびコルゲートフィンのいずれでもよい。

#### 【0020】

【実施例】図7のヒートシンクにおいて、基板(5)の厚み(tb)を5.0mm、プレートフィン(6)の厚み(tf)を1.0mm、プレートフィン(6)の高さ(H)を20.0mm、プレートフィン(6)の長さ(L)を75.0mm、プレートフィン(6)の中心間ピッチ(P)を5.0mmとする。

【0021】この実施例と、上記寸法と寸法で基板とプレートフィンをろう付けした比較例において、風速を変化させて熱抵抗を調べた結果を図15のグラフに示す。同グラフの線(イ)が実施例のものであり、線(ロ)が比較例のものであるが、両者に熱抵抗の差がなく、同等の性能を発揮していることが分かる。上記実施例のヒートシンクにおいて、いま各部の寸法を変えた場合のフィン効率および熱抵抗を以下に示す。

【0022】図16は、基板の厚み(tb)とフィン効率の関係を示す。基板の厚み(tb)が厚いほど、全体のフィン効率は向上するが、厚すぎると重量が顕著に増加するため現実的ではない。また、薄すぎると極端に全体のフィン効率が低下する。したがって、基板の厚み(tb)は1～

10mmが適当な範囲(A)である。

【0023】図17は、比較的低風速条件でのプレートフィンの厚み(tf)を変えた場合のフィン効率を示す。厚み(tf)が0.05mm未満ではフィン効率が極端に低下し、厚み(tf)が増せばフィン効率が向上するが、厚すぎるとヒートシンクの重量が増加して、現実的ではない。したがって、プレートフィンの厚み(tf)は、0.05～2.0mmの範囲(B)が適当である。

【0024】図18は、プレートフィンの高さ(H)とフィン効率の関係を示す。プレートフィンの高さ(H)は低いほどよいが、低すぎると伝熱面積の増加が減少するため放熱効果が小さくなるので、現実的な下限としては10mmであり、一方フィン効率を考慮すると上限値は100mmであると考えられるので、プレートフィンの高さ(H)の適当な範囲(C)は、10～100mmである。

【0025】図19は、プレートフィンの中心間ピッチ(P)と熱抵抗の関係を示す。プレートフィンの中心間ピッチ(P)が5mmを超えると伝熱面積が減少し、熱伝達率も低下するため熱抵抗は大きくなる。また、プレートフィンの中心間ピッチ(P)が小さいほど熱抵抗は小さくなるが、大きくなりすぎると境界層が隣り合ったプレートフィンの境界層と合体するため、フィン効率が小さくなる。さらに、プレートフィンの中心間ピッチ(P)が小さすぎると圧力損失が極端に増大し、現実的ではない。したがって、プレートフィンの中心間ピッチ(P)は0.5～5.0mmの範囲(D)が適当である。

#### 【0026】

【発明の効果】本発明のヒートシンクの製造法によれば、簡単な構造のボンチの使用でよく、またフィンのかしめ止めの前フィン姿勢保持のために特に別の部品を必要としないので、ヒートシンクの製造を安価かつ能率的に行ないうる。

#### 【図面の簡単な説明】

【図1】鍛造より基板に溝を形成する状態を切欠いた正面図である。

【図2】本発明の実施の形態1においてプレートフィンを基板にかしめ止める前の状態を示す正面図である。

【図3】同プレートフィンを基板にかしめ止めた後の状態を示す正面図である。

【図4】図3において基板にプレートフィンの基部をかしめ止めた状態を示す部分詳細拡大断面図である。

【図5】基板に角のある通常の溝を設けこれにプレートフィンの基部をはめ込んだ状態を示す部分断面図である。

【図6】図5の溝を有する基板にプレートフィンの基部をかしめ止めた図4に相当する断面図である。

【図7】実施の形態1により製造されたヒートシンクの部分斜視図である。

【図8】プレートフィンの第1変形例を示す斜視図であ

る。

【図9】プレートフィンの第2変形例を示す斜視図である。

【図10】プレートフィンの第3変形例を示す斜視図である。

【図11】プレートフィンの第4変形例を示す斜視図である。

【図12】本発明の実施の形態2においてプレートフィンを基板にかしめ止める前の状態を示す正面図である。

【図13】同プレートフィンを基板にかしめ止めた後の状態を示す正面図である。

【図14】本発明の実施の形態3により得られたヒートシンクの側面図である。

【図15】実施例と比較例における風速を変化した場合の熱抵抗を示すグラフである。

【図16】基板の厚みとフィン効率の関係を示すグラフである。

【図17】比較的低風速条件でのプレートフィンの厚みを変えた場合のフィン効率を示すグラフである。

【図18】プレートフィンの高さでフィン効率の関係を示すグラフである。

【図19】プレートフィンの中心間ピッチと熱抵抗の関\*

\*係を示すグラフである。

【符号の説明】

(2) : 櫛歯状垂下突条

(3)(8)(27) : ポンチ

(4) : 溝

(4a) : 凸弧状部

(4b)(10b)(23b)(25b) : かしめ止め部

(5)(24)(30) : 基板

(5a)(24a) : 基板平坦部

(6a)(18a)(19b) : プレートフィンの基部

(7)(26) : 板状部

(7a)(26a) : 板状部の横断面V状先端

(12)(29)(34) : ヒートシンク

(6)(14)(16)(18)(19) : プレートフィン

(21) : コルゲートフィン

(21a) : コルゲートフィンの波頂部

(21b) : コルゲートフィンの垂直端部

(22) : 第1溝

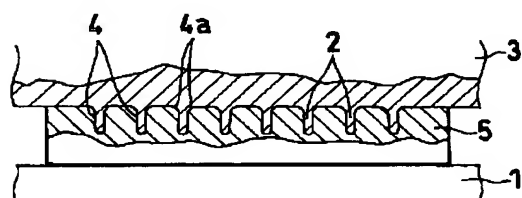
(23) : 第2溝

(25) : かしめ用棒

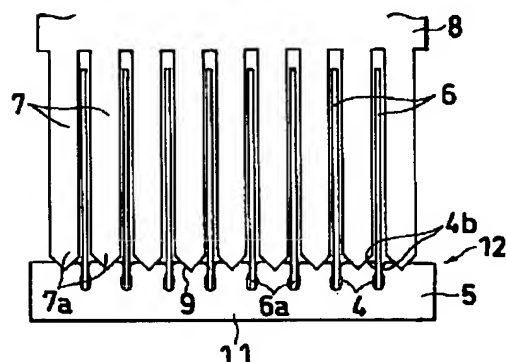
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(W2) : 波頂部の外幅

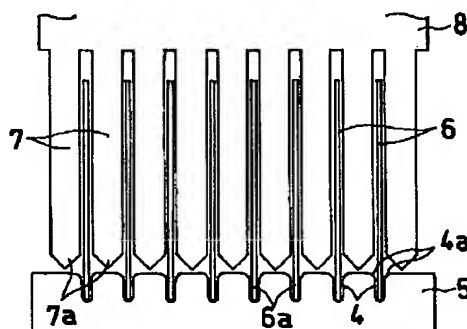
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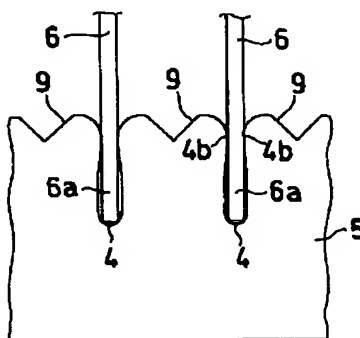
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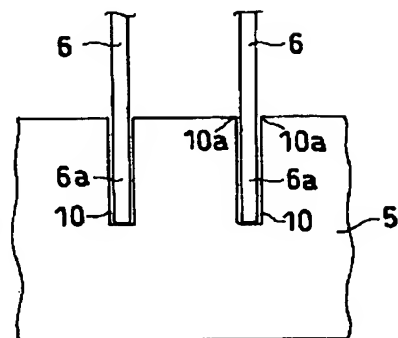
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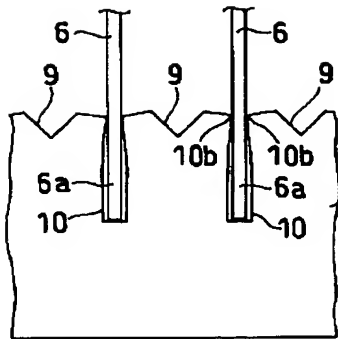
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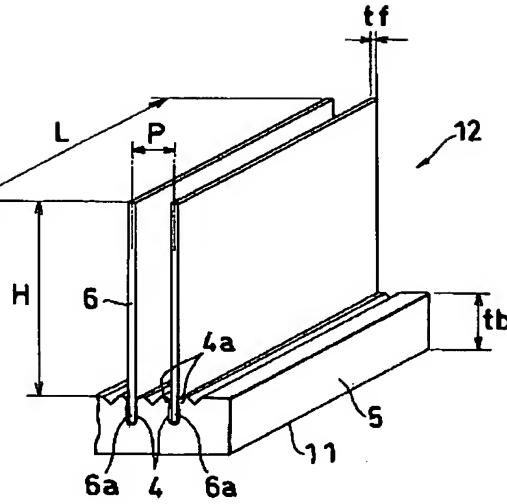
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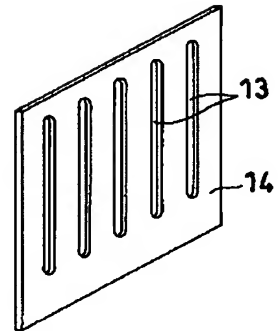
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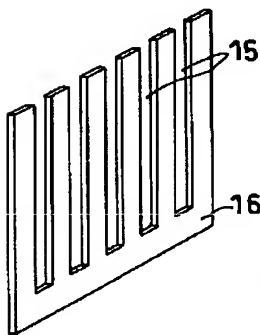
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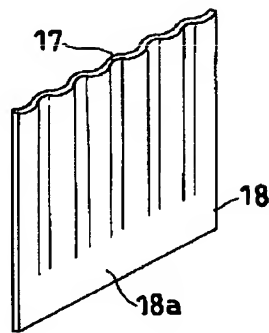
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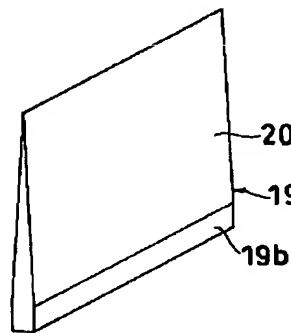
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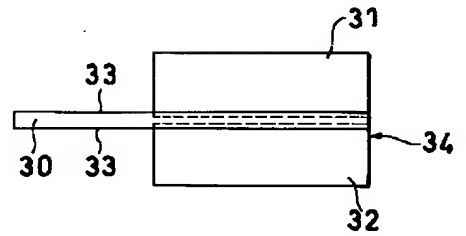
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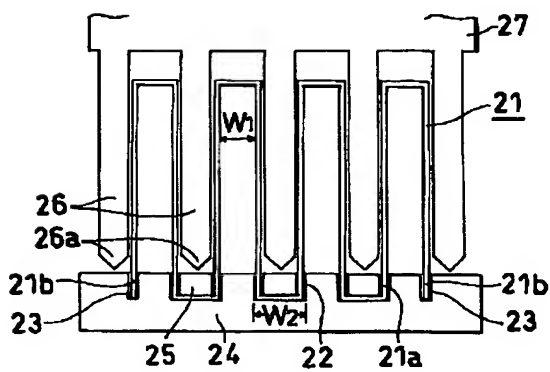
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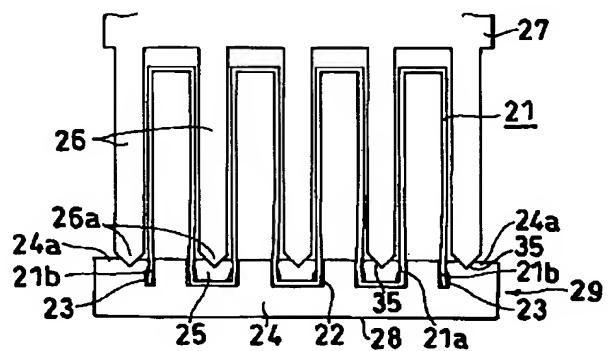
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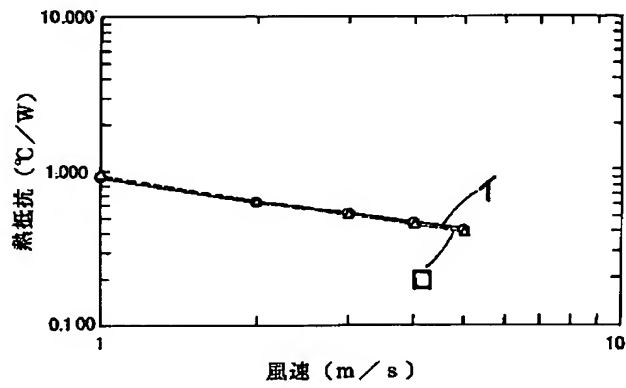
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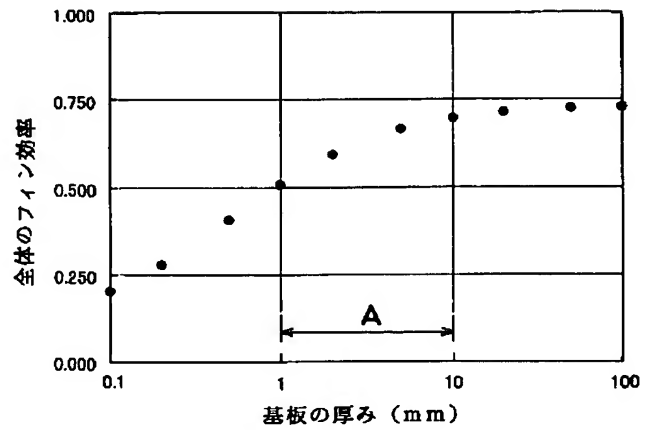
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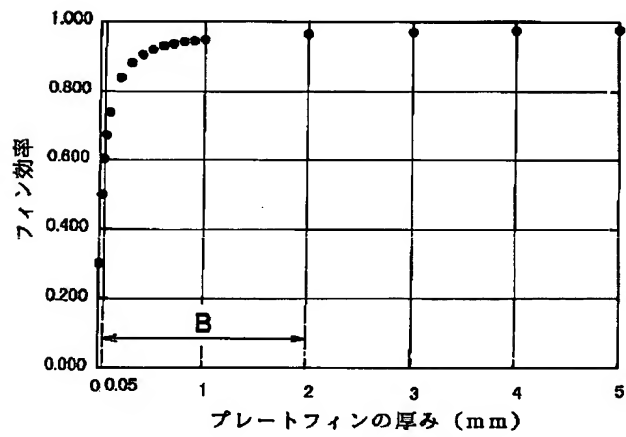
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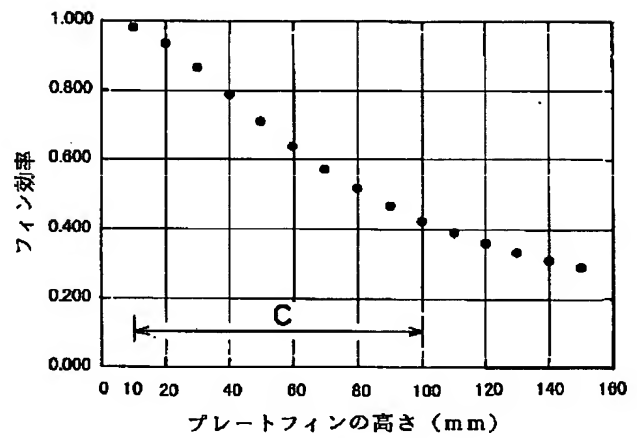
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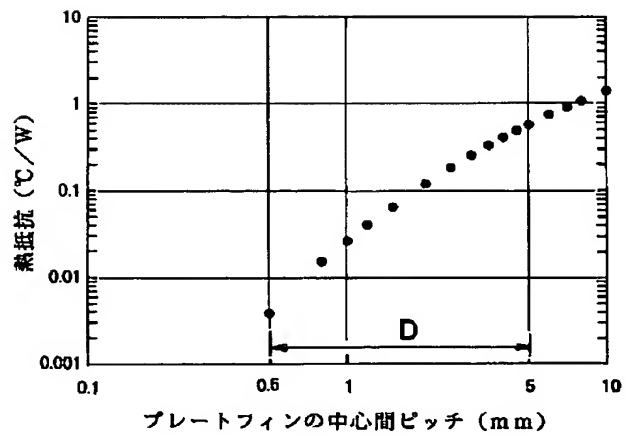
【図17】



【図18】



【図19】



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Bibliography.

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H05K 7/20  
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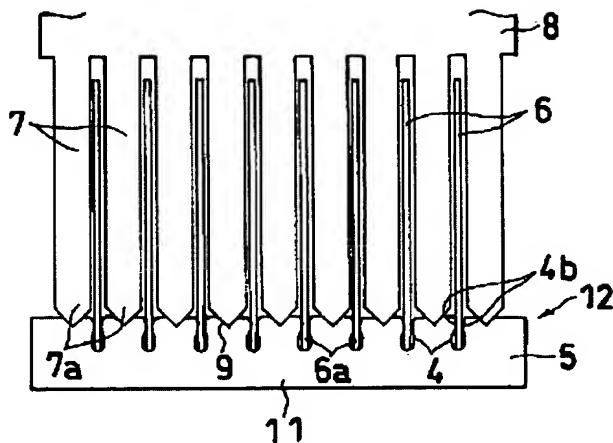
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Summary.

(57) [Abstract]  
[Technical problem] Use of the punch of easy structure is sufficient, and before closing a fin to a substrate and stopping it, it is made not to need another parts for fin posture maintenance.  
[Means for Solution] The manufacturing method of a heat sink forms many slots 4 which set a predetermined interval on one side of a plate-like substrate, and have a flute width [ a little ] larger than the thickness of base 6a of the plate fin 6 in the shape of parallel. With the punch 8 of the press which inserted base 6a of the plate fin 6 in each slot 4 of a substrate 5, and was equipped with the plate-like part 7 of the plate fin 6 of between adjacent plate fin 6 and ends which is made as [ locate / outside / immediately ] and has cross-section V-like nose-of-cam 7a in the shape of a ctenidium. Nose-of-cam 7a of a plate-like part 7 is stuffed into substrate flat part 5a corresponding to each plate-like part 7, and the base 6a both sides of the plate fin 6 inserted in each slot 4 are closed and stopped. It is.

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CLAIMS

[Claim(s)]

[Claim 1] The manufacturing method of the heat sink characterized by the bird clapper from the process which closes and stops the base both sides of the plate fin which stuffed the nose of cam of a plate-like part into the substrate flat part corresponding to each plate-like part, and was inserted in each slot with the punch of the press equipped with the plate-like part in the shape of a ctenidium characterized by providing the following. The process which forms many slots which set a predetermined interval at least on one side among both sides of a plate-like substrate, and have a flute width [ a little ] larger than the thickness of the base of a plate fin in the shape of parallel. The process which inserts the base of a plate fin in each slot on the substrate. the plate fin of between adjacent plate fins and ends -- do to be located immediately outside -- and a cross-section V-like nose of cam

[Claim 2] The manufacturing method of the heat sink according to claim 1 which forms both the openings edge of the slot for plate fin base insertion in a cross-section convex arc, and is characterized by making it deform plastically so that field contact of a part of convex arc section may be carried out in the base of a plate fin at the time of a caulking stop.

[Claim 3] The manufacturing method of the heat sink according to claim 1 or 2 with which thickness of a substrate is characterized by the height of 0.05-2.0mm and a plate fin being [ the pitch between centers of 10-150mm and a plate fin ] 1-10mm for the thickness of 1-10mm and a plate fin.

[Claim 4] The manufacturing method of the heat sink characterized by the bird clapper from the process which carries out the pressure welding of the opposite side to a groove face while closing and stopping one side of the both-sides folding vertical section of the wave-crest section of the corrugated fin which stuffed the nose of cam of a plate-like part into the rod for

caulkings corresponding to each plate-like part, and was inserted in the slot with the punch of the press equipped with the plate-like part in the shape of a cam characterized by providing the following. The process which forms many slots which set an interval [ a little ] narrower than the inner width of face of the wave-crest section of a corrugated fin at least on one side among both sides of a plate-like substrate, and have a flute width a little from width of face outside the wave-crest section of a corrugated fin. The process which inserts the wave-crest section of one of the two of a corrugated fin in the slot on the substrate. The process which has cross-section width of face [ a little ] smaller than the inner width of face of the wave-crest section, and inserts the rod for caulking of the same quality of the material as a substrate in each slot through the aforementioned wave-crest section. It is made as [ locate / in the waves which a corrugated fin adjoins ], and is a cross-section V-like nose of cam.

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**DETAILED DESCRIPTION**

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to the manufacturing method of a heat sink.

[0002]

[Description of the Prior Art] While forming conventionally many laesuras which set a predetermined interval on one side of a plate-like substrate, and have a flute width a little from the thickness of the base of a plate fin as a manufacturing method of a heat sink in the shape of parallel By forming the concave which spread one by one toward the opening edge among both slots by making two laesuras at a time into a pair The wall which prepares the convex wall section for caulking in the both sides of a concave in the shape of confrontation, and counters the convex wall for caulking The convex wall section for fixation, and nothing, By meeting a laesura and moving the press section of the fixture for caulking between the convex walls for both caulking which confront each other, after inserting the base of a plate fin in each slot By pressing the convex wall section for caulking to a plate fin side, meeting and subsequently to a laesura, moving the bulge projected part of a processing fixture The part intermedia of the convex wall section for caulking is crashed in the shape of \*\*\* toward a plate fin side, and what closes a plate fin to a substrate and stops it is known (refer to the patent No. 2715890 official report).

[0003]

[Problem(s) to be Solved by the Invention] According to the manufacturing method of the conventional above-mentioned heat sink, since it not only needs the processing fixture of complicated structure, but the press section and the bulge projected part of a processing fixture are met and moved to a laesura, the posture of a plate fin in which the base was inserted in each concave at this time must be made to hold, and, for the reason, some parts are needed.

[0004] The purpose of this invention is to offer the manufacturing method of the heat sink which

use of the punch of easy structure is sufficient as, and does not need the parts for the above fin posture maintenance.

[0005]

[Means for Solving the Problem] The manufacturing method of the heat sink by invention of a claim 1 The process which forms many slots which set a predetermined interval at least on one side among both sides of a plate-like substrate, and have a flute width [ a little ] larger than the thickness of the base of a plate fin in the shape of parallel, With the punch of the press equipped with the process which inserts the base of a plate fin in each slot on the substrate, and the plate-like part of the plate fin of between adjacent plate fins and ends which is made as [ locate / outside / immediately ] and has a cross-section V-like nose of cam in the shape of a ctenidium The nose of cam of a plate-like part is stuffed into the substrate flat part corresponding to each plate-like part, and it consists of a process which closes and stops the base both sides of the plate fin inserted in each slot.

[0006] The manufacturing method of the heat sink by invention of a claim 2 forms both the openings edge of the slot for plate fin base insertion in a cross-section convex arc, and is made to deform it plastically in invention of a claim 1, at the time of a caulking stop, so that field contact of a part of convex arc section may be carried out in the base of a plate fin.

[0007] For the thickness of 1-10mm and a plate fin, in invention of claims 1 or 2, the height of 0.05-2.0mm and a plate fin is [ the thickness of a substrate / the pitch between centers of 10-150mm and a plate fin of the manufacturing method of the heat sink by invention of a claim 3 ] 1-10mm.

[0008] The manufacturing method of the heat sink by invention of a claim 4 The process which forms many slots which set an interval [ a little ] narrower than the inner width of face of the wave-crest section of a corrugated fin at least on one side among both sides of a plate-like substrate, and have a flute width [ a little ] larger than width of face outside the wave-crest section of a corrugated fin, The process which inserts the wave-crest section of one of the two of a corrugated fin in the slot on the substrate, and the process which has cross-section width of face [ a little ] smaller than the inner width of face of the wave-crest section, and inserts the rod for caulking of the same quality of the material as a substrate in each slot through the aforementioned wave-crest section, With the punch of the press equipped with the plate-like part which is made as [ locate / in the waves which a corrugated fin adjoins ], and has a cross-section V-like nose of cam in the shape of a ctenidium The nose of cam of a plate-like part is stuffed into the rod for caulking corresponding to each plate-like part, and while closing and stopping one side of the both-sides folding vertical section of the wave-crest section of the corrugated fin inserted in the slot, it consists of a process which carries out the pressure welding of the opposite side to a groove face.

[0009] In the above, the good aluminum or the good aluminium alloy (only henceforth "aluminum") of heat-conducting characteristic is used for a substrate, a plate fin, and a corrugated fin.

[0010]

[Embodiments of the Invention] The form of operation of this invention is explained with reference to a drawing below.

the form 1 of operation -- the form of this operation shows the manufacturing method of the heat sink of claims 1 and 2 by drawing 1 - drawing 4 , and drawing 7 First, many slots which set a predetermined interval on one side of the plate-like substrate made from aluminum, and have a flute width [ a little ] larger than the thickness of the base of a plate fin with forging are formed in the shape of parallel. That is, it is the bed (1) of the 1st press about a plate-like substrate. It carries and is a ctenidium-like suspension protruding line (2). Punch of the 1st press which it has in the shape of parallel (3) It pressurizes and is the above-mentioned predetermined slot (4). Substrate which it has (5) It makes. this time -- slot (4) \*\*\*\* -- the thing which both the openings edge is formed [ thing ] in a cross-section convex arc, and makes the convex arc section (4a) provide -- it is -- punch (3) Ctenidium-like suspension protruding line (2) It is obtained by making the cross section into the configuration in which this is formed ( refer to drawing 1 </A> ). The above-mentioned slot (4) Although obtained with forging, you may form by

cutting.

[0011] Next, it is a substrate (5). It moves to the bed (illustration abbreviation) of the 2nd press, and is a substrate (5). Each slot (4) Plate fin (6) After inserting in a base (6a), adjacent plate fin (6) Plate fin (6) of between comrades and ends do to be located immediately outside — and plate-like part (7) which has a cross-section V-like nose of cam (7a) Punch (8) (refer to drawing 2) of the 2nd press which it had in the shape of a ctenidium Each plate-like part (7) It is a plate-like part (7) to a corresponding substrate flat part (5a). A nose of cam (7a) is pushed in and it is a cross-section V-like indentation (9) to this. While attaching, it is each slot (4). Inserted-in plate fin (6) Base (6a) both sides are closed and stopped (refer to drawing 3). It is a plate fin (6) in a part of convex arc section (4a) at the time of this caulking stop. A base (6a) is made to deform plastically so that field contact may be carried out, and the caulking stop section (4b) of large field contact is obtained (refer to drawing 4). plate-like part (7) vertical length — plate fin (6) Substrate (5) from — a part for the distance which carries out descent movement in order to stuff the nose of cam (7a) into a substrate flat part (5a) at least from projection height — it is made for a long time

[0012] As the convex arc section may not necessarily be in both the openings edge in a slot and it is shown in drawing 5, it is an angle (10a). You may form the usual slot (10) which exists. In this case, it is the caulking stop section (10b) of the narrow field contact near a line contact to drawing 6 at the time of a caulking stop. It will obtain. therefore, plate fin (6) you stop making it go away — front slot (4) \*\*\*\* — it is more desirable for the convex arc section (4a) to be in both the openings edge

[0013] It is a substrate (5) as shown in drawing 7 through the above-mentioned process. Although a field with a fin and an opposite side obtain heating element clamp faces (11), such as a semiconductor device, and the heat sink (12) with which it was made before a caulking stop and punch (8) \*\*\*\* — substrate (5) Each slot (4) Plate fin (6) After inserting in a base (6a) Adjacent plate fin (6) Plate fin of between comrades and ends (6) Plate-like part of the shape of a ctenidium made as [ locate / outside / immediately ] (7) Since it has Each plate fin (6) It will be inserted from the both sides and is a plate fin (6). It can prevent falling.

[0014] Although the form of a plate fin has the common rectangle-like thing to which processing of what as shown in drawing 7 is not given, either (Refer to drawing 8), [ the plate fin (14) with which two or more vertical long holes (13) were opened, and ] (Refer to drawing 9), [ the plate fin (16) with which two or more vertical long notches (15) were opened from the top, and ] Base (18a) The plate fin (18) (refer to drawing 10) and base (19b) which leave with a flat and have up the wavelike section (17) crooked wavelike [ in view of a flat surface ] after this It leaves with a flat. A thing like a plate fin (19) and (referring to drawing 11) which has the taper section (20) which made the upper part with the taper after this is also adopted suitably.

[0015] the form 2 of operation — the form of this operation shows the manufacturing method of the heat sink of a claim 4 by drawing 12 — drawing 13 The 1st press is used in the same way as the form 1 of operation. first, with forging It is the wave-crest section (21a) of a corrugated fin (21) with an angle to one side of the plate-like substrate made from aluminum. An interval [ a little ] narrower than inner width of face (W1) is set, and it is the wave-crest section (21a) of a corrugated fin (21). While forming many 1st slot (22) which has a flute width [ a little ] larger than outside width of face (W2) The 2nd slot (23) which sets the respectively same interval as the above, and has a flute width [ a little ] larger than the thickness of the perpendicular edge (21b) of a corrugated fin (21) is formed in the outside of this slot on the ends (22), and the substrate (24) which has two kinds of slots (22) and (23) is obtained.

[0016] Next, a substrate (24) is moved to the bed (illustration abbreviation) of the 2nd press, and it is the wave-crest section (21a) of one of the two of a corrugated fin (21) to the 1st slot (22) on the substrate (24). While inserting in It is the perpendicular edge (21b) of a corrugated fin (21) to the 2nd slot (23) on the substrate (24). After inserting in, It is the aforementioned wave-crest section (21a) to the 1st slot (22). It minds and is the wave-crest section (21a). It has cross-section width of face [ a little ] smaller than inner width of face (W1), and the rod for caulking (25) of the same quality of the material as a substrate (24) is inserted in (refer to drawing 12). then, the vertical section of the waves and ends where a corrugated fin (21) adjoins each other —

— do to be located immediately outside — and cross-section V-like nose of cam (26a) The plate-like part (26) which it has with the punch (27) of the 2nd press which it had in the shape of a ctenidium The rod for caulking (25) and substrate flat part (24a) corresponding to each plate-like part (26) Nose of cam of a plate-like part (26) (26a) It pushes in. While the indentation (35) of a cross-section V type is attached to these The wave-crest section of the corrugated fin (21) inserted in the 1st slot (22) (21a) One side of a both-sides folding vertical section, and perpendicular edge of a corrugated fin (21) (21b) While closing and stopping one side, the pressure welding of these opposite sides is carried out to a groove face. A field with the fin of a substrate (24) and an opposite side obtain a heating element clamp face (28) and the heat sink (29) with which it was made.

[0017] It is the superior horn (25a) of the rod for caulking (25) at the time of this caulking stop. It reaches and is the wave-crest section (21a) of a corrugated fin (26) about the superior horn (23a) outside a slot (23). One side of a both-sides folding vertical section, and perpendicular edge of a corrugated fin (21) (21b) You make it deform plastically so that one side may be contacted, and the caulking stop section (25b) (23b)

[0018] Although a heat sink (29) is obtained through the above-mentioned process It is the wave-crest section (21a) of one of the two of a corrugated fin (21) to the 1st slot (22) of before a caulking stop and a substrate (24). While inserting in It is the perpendicular edge (21b) of a corrugated fin (21) to the 2nd slot (23) on the substrate (24). It is the aforementioned wave-crest section (21a) to the 1st slot (22) after inserting in. Since it minds and the rod for caulking (25) is inserted in, a corrugated fin (21) keeps the posture right. In addition, in the thing of the shape of not the letter of suspension but a standup, the 2nd slot (23) is unnecessary like illustration of the both sides of a corrugated fin.

[0019] the gestalt 3 of operation — the gestalt of this operation shows the manufacturing method of the heat sink of different claims 1 and 4 from the manufacturing method of the heat sink of drawing 1 — drawing 4 , and drawing 7 by drawing 14 , and this inclines toward both sides of a substrate (30), makes them possess a fin (31) and (32), and obtains the heat sink (34) which made the remaining both-sides flat sides with the heating element clamp face (33) As for both the heating element clamp face (33), one of one side or both sides are used if needed. Any of the above-mentioned plate fin and a corrugated fin are sufficient as the gestalt of a fin.

[0020]

[Example] It sets to the heat sink of drawing 7 , and is a substrate (5). They are 5.0mm and a plate fin (6) about thickness (tb). They are 1.0mm and a plate fin (6) about thickness (tf). Height (H) 20.0mm and plate fin (6) Length (L) 75.0mm and plate fin (6) Pitch between centers (P) You may be 5.0mm.

[0021] In this example and the example of comparison which soldered the substrate and the plate fin with the above-mentioned size and this size, the result which the wind speed was changed and investigated thermal resistance is shown in the graph of drawing 15 . Although the line (b) of this graph is the thing of an example and a line (b) is the thing of the example of comparison, both do not have the difference of thermal resistance and it understands [ demonstrating the equivalent performance or ]. In the heat sink of the above-mentioned example, the fin efficiency and thermal resistance at the time of changing the size of each part now are shown below.

[0022] Drawing 16 shows the thickness (tb) of a substrate, and the relation of fin efficiency. Although the whole fin efficiency improves so that the thickness (tb) of a substrate is thick, since a weight will increase notably if too thick, it is not realistic. Moreover, if too thin, the whole fin efficiency will fall extremely. Therefore, the thickness (tb) of a substrate is a range (A) with 1–10 suitablemm.

[0023] Drawing 17 shows the fin efficiency at the time of changing the thickness (tf) of the plate fin in low wind-speed conditions comparatively. Although fin efficiency will improve if fin efficiency falls [ thickness (tf) ] extremely by less than 0.05mm and thickness (tf) increases, if too thick, the weight of a heat sink increases and it is not realistic. Therefore, the range of 0.05–2.0mm (B) is suitable for the thickness (tf) of a plate fin.

[0024] Drawing 18 is the height (H) of a plate fin. The relation of fin efficiency is shown. height

(H) of a plate fin although a low is good, since the thermolysis effect becomes small in order that the increase in heat transfer area may decrease, if too low, I think that it is 10mm as a realistic minimum, and an upper limit is 100mm if fin efficiency is taken into consideration on the other hand -- having -- height (H) of a plate fin The suitable range (C) is 10-100mm.

[0025] Drawing 19 is the pitch between centers of a plate fin (P). The relation of thermal resistance is shown. Pitch between centers of a plate fin (P) Since heat transfer area will decrease and a heat transfer rate will also fall if it exceeds 5mm, thermal resistance becomes large. Moreover, pitch between centers of a plate fin (P) Although thermal resistance becomes small so that it is small, fin efficiency becomes small, in order to coalesce in the boundary layer of the plate fin with which the boundary layer adjoined each other, if it becomes large too much. Furthermore, pitch between centers of a plate fin (P) If too small, pressure loss increases extremely and is not realistic. Therefore, pitch between centers of a plate fin (P) The range of 0.5-5.0mm (D) is suitable.

[0026]

[Effect of the Invention] According to the manufacturing method of the heat sink of this invention, use of the punch of easy structure is sufficient, and since another parts are not especially needed for front fin posture maintenance of the caulking stop of a fin, a heat sink can be manufactured cheaply and efficiently.

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[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is notch \*\*\* front view about the state of forming a slot in a substrate from forging.

[Drawing 2] It is the front view showing the state before closing a plate fin to a substrate and stopping it in the gestalt 1 of operation of this invention.

[Drawing 3] It is the front view showing the state after closing this plate fin to a substrate and stopping it.

[Drawing 4] It is the partial detailed expanded sectional view showing the state where the base of a plate fin was closed and stopped to the substrate in drawing 3.

[Drawing 5] It is the fragmentary sectional view showing the state where prepared the usual slot which has an angle in a substrate, and the base of a plate fin was inserted in this.

[Drawing 6] It is a cross section equivalent to drawing 4 which closed and stopped the base of a plate fin to the substrate which has a slot on drawing 5.

[Drawing 7] It is the partial perspective diagram of the heat sink manufactured according to the gestalt 1 of operation.

[Drawing 8] It is the perspective diagram showing the 1st modification of a plate fin.

[Drawing 9] It is the perspective diagram showing the 2nd modification of a plate fin.

[Drawing 10] It is the perspective diagram showing the 3rd modification of a plate fin.

[Drawing 11] It is the perspective diagram showing the 4th modification of a plate fin.



[Drawing 12] It is the front view showing the state before closing a plate fin to a substrate and stopping it in the gestalt 2 of operation of this invention.

[Drawing 13] It is the front view showing the state after closing this plate fin to a substrate and stopping it.

[Drawing 14] It is the side elevation of the heat sink obtained according to the gestalt 3 of operation of this invention.

[Drawing 15] It is the graph which shows the thermal resistance at the time of changing the wind speed in an example and the example of comparison.

[Drawing 16] It is the graph which shows the thickness of a substrate, and the relation of fin efficiency.

[Drawing 17] It is the graph which shows the fin efficiency at the time of changing the thickness of the plate fin in low wind-speed conditions comparatively.

[Drawing 18] It is the graph which shows the height of a plate fin, and the relation of fin efficiency.

[Drawing 19] It is the graph which shows the pitch between centers of a plate fin, and the relation of thermal resistance.

#### [Description of Notations]

(2) : ctenidium-like suspension protruding line

(3), (8), (27): Punch

(4) : slot

(4a): Convex arc section

(4b) (10b) (23b) (25b) : caulking stop section

(5), (24), (30) : Substrate

(5a) (24a) : substrate flat part

(6a) The base of a plate fin (18a) (19b)

(7), (26) : Plate-like part

(7a) (26a) : cross-section V-like nose of cam of a plate-like part

(12), (29), (34): Heat sink

(6), (14), (16), (18), (19) : Plate fin

(21): Corrugated fin

(21a) : the wave-crest section of a corrugated fin

(21b) : the perpendicular edge of a corrugated fin

(22): The 1st slot

(23): The 2nd slot

(25): The rod for caulking

(W1) Inner width of face of the wave-crest section

(W2) Width of face outside the wave-crest section

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[Translation done.]

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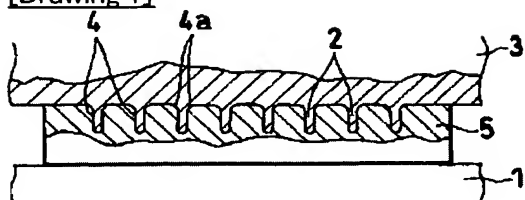
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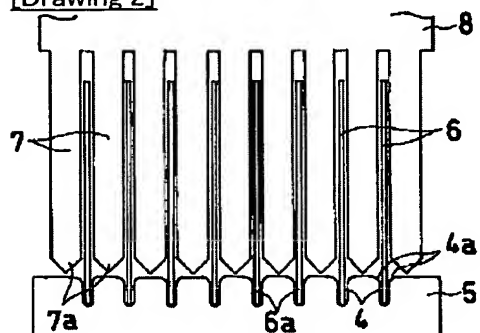
#### DRAWINGS

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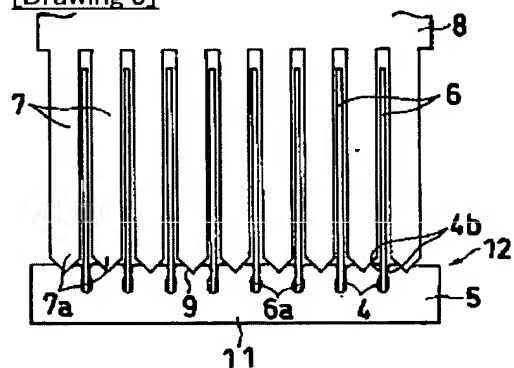
[Drawing 1]



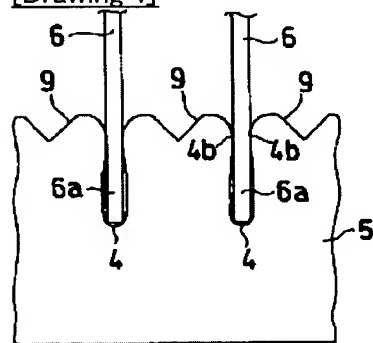
[Drawing 2]



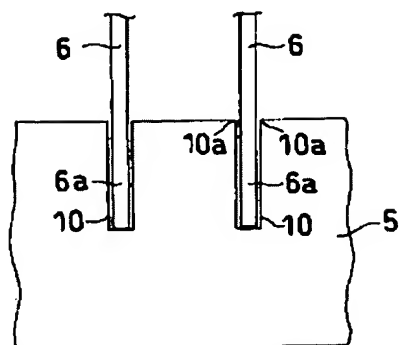
[Drawing 3]



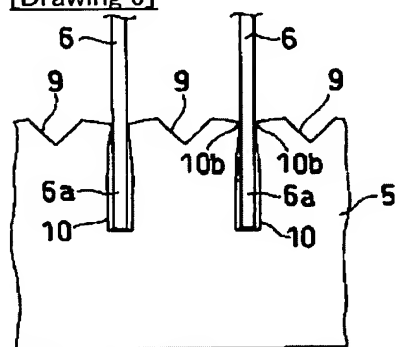
[Drawing 4]



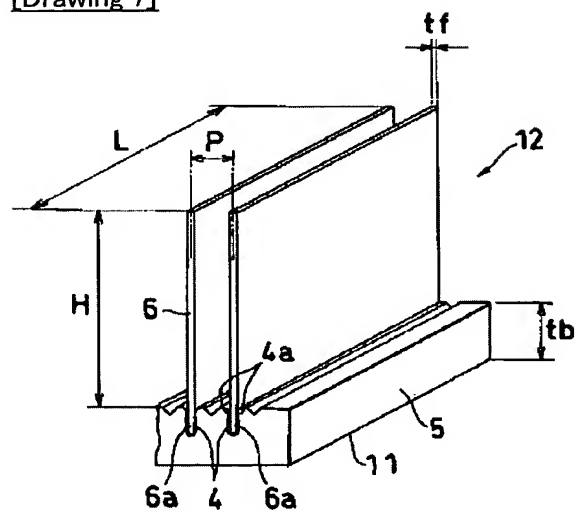
[Drawing 5]



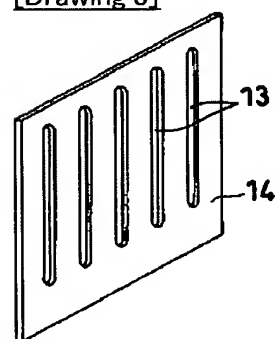
[Drawing 6]



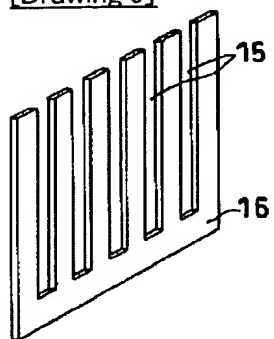
[Drawing 7]



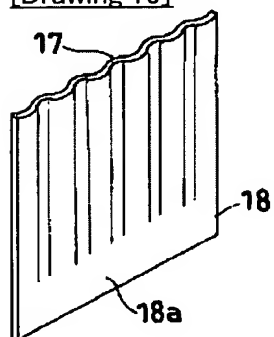
[Drawing 8]



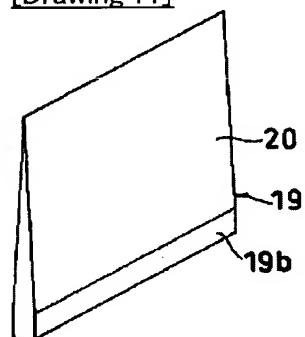
[Drawing 9]



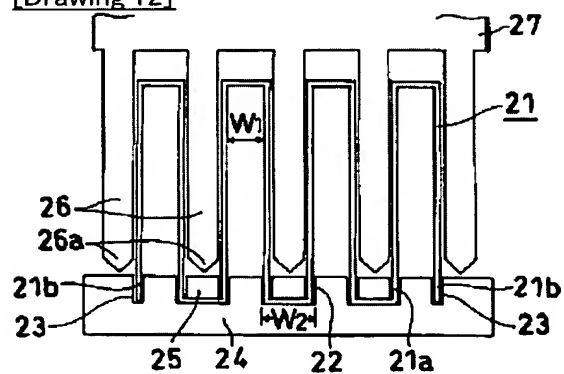
[Drawing 10]



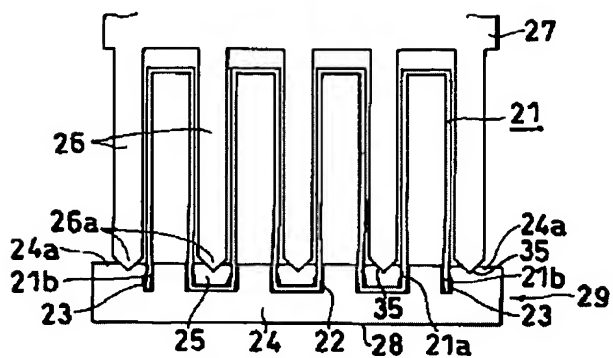
[Drawing 11]



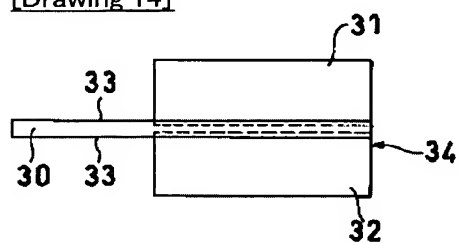
[Drawing 12]



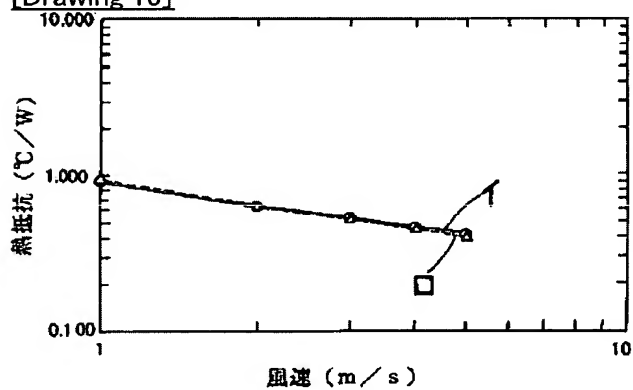
[Drawing 13]



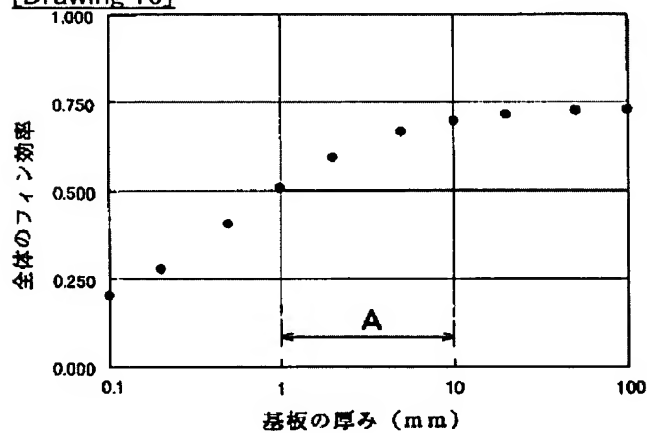
[Drawing 14]



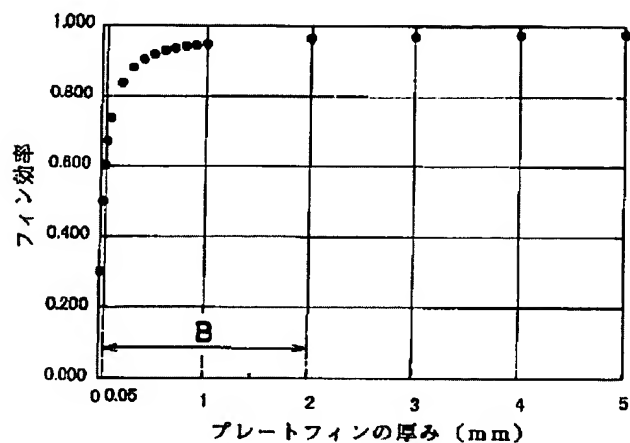
[Drawing 15]



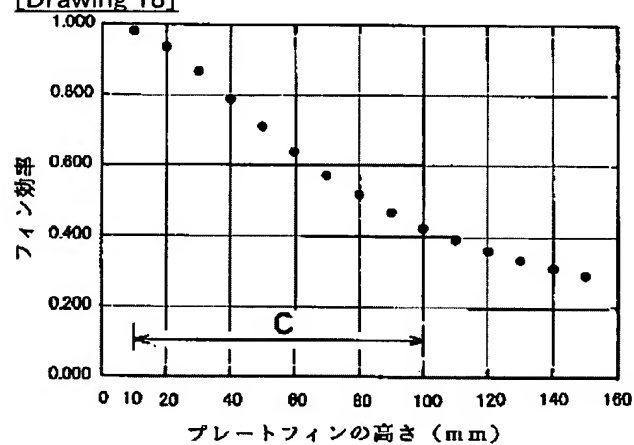
[Drawing 16]



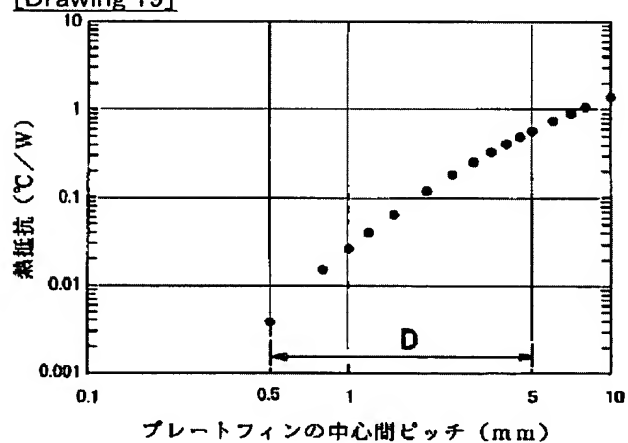
[Drawing 17]



[Drawing 18]



[Drawing 19]



[Translation done.]